INSTREAM FLOWS IN WASHINGTON: PAST AND PRESENT

8/14/03

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INTRODUCTION –PURPOSE AND DEFINITION

Purpose

This paper is designed for use in electronic format. Much supporting documentation is omitted because links are included to those supporting documents.

The purpose of this paper is to describe how flows are defined and established in the state of Washington. This paper outlines how instream flows have been established in past years within the state, and describes new issues related to planning and management of flows.

The paper is intended to offer assistance for watershed planning, particularly to watershed planning units formed under the Watershed Planning Act (Chapter 90.82 Revised Code of Washington [RCW]) in their efforts to address stream flows. Under the Act, all planning units must include strategies for ensuring sufficient water to meet instream flows in their final watershed plan. Some planning units have also elected to set or revise instream flows. This paper describes background policies and options for use by the planning units in determining how stream flows will be addressed in their plan.

Audience

The primary audience for this paper is watershed planning groups. These include Ecology's "focus" watersheds (Skagit, Methow, Dungeness) and other watershed planning efforts occurring under Chapter 90.82 RCW. Other planning groups, legislators, federal agencies, governmental cabinet groups, water managers and many more also may find the information useful, but the target audience is watershed planning groups because of their immediate need for historical perspective, information, methods and approaches.

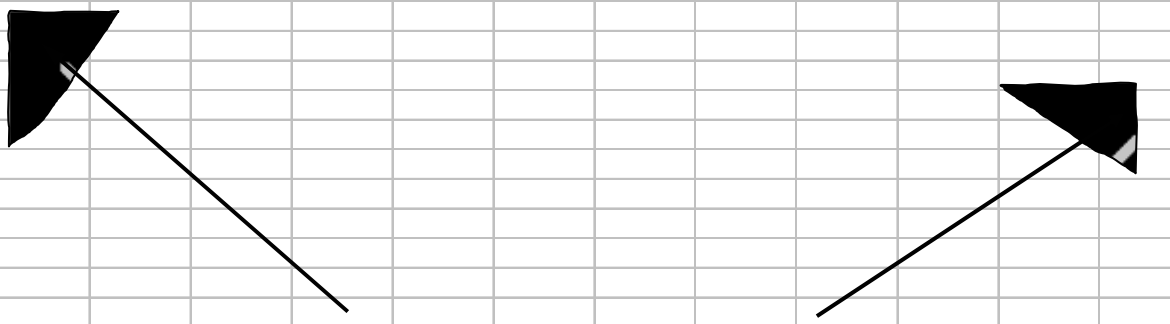
Definitions

A glossary of key terms, phrases, and acronyms is in the appendix on page 28.
For the purposes of this paper, the term "stream flow" refers to the quantity of water flowing in a stream or river and is typically expressed as a rate of flow (*e.g.*, cubic feet per second or second-feet) but does not guarantee the flow will always occur. The stream flow can be measured in a river at any given time.

The term "instream flow" refers to a specific stream flow that is identified for purposes of planning or management of a stream or river. The instream flow is usually defined as a stream flow that is adequate to meet specific needs or management objectives for the river. Instream flows are usually established in legal form, typically through adoption of a state rule. And they are usually defined as a minimum stream flow – *i.e.*, the instream flow for a river is met if the stream flow is at or above the flow rate specified by the instream flow. Such flows, once set by rule, are a water right under the law and are a limitation on subsequently issued water rights. (See Figure 1)

Ecology has traditionally not set flows at a level higher than the 50% exceedence flow[1] . Figure one illustrates the hypothetical relationship between a flow set by rule and flows that might actually be in the stream. In the case of a stream like Figure One, Ecology would probably have closed the stream to further appropriations for the period when the flows would not be met in this case, at least half the time.

Month	Est. Flow	50%
Oct	13,000	9910
Nov	13,000	14500
Dec	11,000	16100
Jan	10,500	15600
Feb	10,500	14600
Mar	10,500	13200
Apr	12,000	14100
May	12,000	19000
Jun	12,000	22600
Jul	10,500	18100
Aug	10,500	10600
Sep	10,500	8350



Streams where instream flows are set by rule can be accessed via the website of the Code Reviser's Office <http://slc.leg.gov/wacbytitle.htm>. An example of instream flows set by rule is in the Nooksack Basin, Water Resources Inventory Area 1, (Ch. 173-501 Washington Administrative Code [WAC]).

WHY ARE FLOWS IMPORTANT?

Flows are important because water is important. Flows in a stream are a "zero sum game" – there is a finite amount of water available at any given moment and if it is being used for one thing; it generally cannot be used for another. Water is needed in streams to protect instream resources –

[1] 50% exceedence flow is the flow for which we expect flows higher 50% of the time and lower 50% of the time.

including the preservation of wildlife, fish, scenic, aesthetic and other environmental values, stock watering and navigational values. Flows affect the health of aquatic systems and resources. Flowing water transports food and young salmon. Fish feed on insects drifting in the current. If water is taken out of a stream for what is termed a "consumptive use" (such as for domestic water supply), it is not available for instream resources. Historically, water diversions were not conditioned with instream flows so that consumptive use of water is allowed regardless of what the stream flow may be and whether or not fish are present in the stream. Senior water rights, that is, water rights senior to an instream flow established by rule, substantially dewater some streams in Washington. Senior water rights are not subject to subsequently adopted instream flows.

Low summer flows can result in fewer fish. Flows can be a crucial determinant in the health of fish

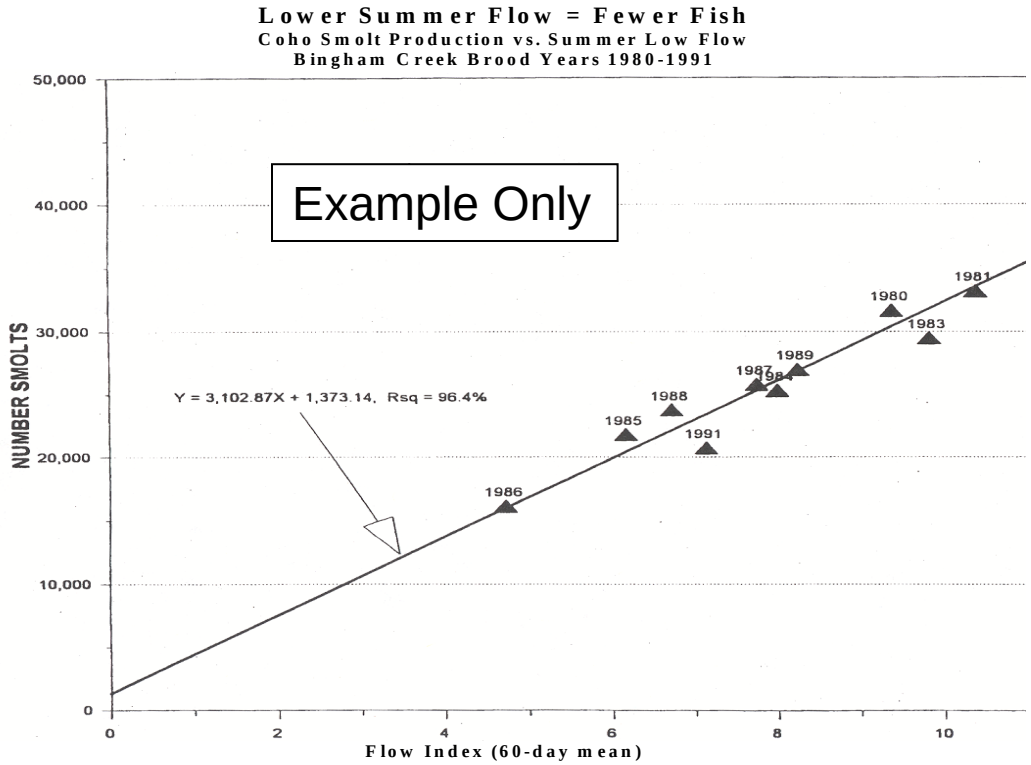


Figure 2 **Low flows generally equate to low fish production.** This example from Bingham Creek (Mason County tributary to the Satsop River) shows as flows increase, the number of smolts also increases.

stocks. As illustrated above, low summer flows can be strongly associated with fewer fish. An example of how this can happen is as follows: As flows subside during the summer, fish congregate in pools. Congregation can increase predation risk, competition for limited resources (*i.e*. food), or perhaps result in entrapment and stranding. Low flows also tend to result in warmer water temperatures which can increase fish mortality.

Flow levels can be a crucial determinant of the health of fish stocks and in the protection and restoration of fish stocks. Treaties and statutes, in state as well as federal laws, such as the Endangered Species Act (ESA) all may have an influence on flows. These documents may contain provisions that require, for example, the maintenance of adequate habitat to maintain healthy fish populations – part of the "adequate habitat" component may be flows. Removing too much water out-of-stream can result in insufficient water for instream resources, including fish.

Stream flow is also important to water quality. In Washington, more and faster flowing water generally means lower water temperatures (other factors are involved). Temperature is a water quality parameter regulated by the state Water Pollution Control Act (Ch. 90.48 RCW). Reduced flows can have an impact on concentrations of substances in the stream. Assuming the amount of the material remains the same, if the amount of water is reduced, the concentration (and often the toxicity) of the material in question is increased because a smaller amount of water is diluting the same amount of the substance of concern. Insufficient flow can contribute to violation of state water quality standards. Flows are considered in issuance of water quality permits.

Federal laws come into play with regard to flows through the Clean Water Act and the Endangered Species Act. For example, the amount of flow affects water quality (regulated by the Clean Water Act) as a factor in the dilution capacity of a water body (as well as for things like temperature and dissolved oxygen, among other parameters). For ESA, clean water is needed to protect fish and so if the water is dirty, it can have a detrimental influence on listed fish species.

Flows can influence instream values besides fish and water quality. Many wildlife species are stream or riparian dependent so if flows are reduced, the associated riparian vegetation can be changed. If, for example, flows are greatly reduced, there will be a reduction in the amount of habitat for such species as the American dipper and kingfisher, which spend a great deal of time in and around streams.

Aesthetic and scenic values are influenced by the level of flow in a stream. The level of flow obviously influences how the stream looks. Less water in a stream generally exposes more of the streambed. Streambeds are oftentimes comprised of rocks and assorted woody debris, which many people find less inviting than a flowing, gurgling stream.

Navigation is affected by flows. High flows are needed for kayaking. If flows are too low, kayakers cannot use the stream for fear of damaging their craft on rocks that would not be a hazard if flows were higher. On a larger scale, in a river like the Columbia, if flows are below a certain level, the river becomes impassable to barges, tugs, and other watercraft because of the lack of draft. There might not be enough water to float the craft high enough to keep it from scraping the bottom of the river.

High flows can also affect on resources. More flow is not always better. High flows can cause flooding and damage to man-made things. High flows can scour salmon gravels and overtop banks and leave fish stranded in fields. High flows can be dangerous to recreationists, such as white-water rafters.

Demands on flows

Biological and economic systems put demands on flows. They each need water to “fuel” their vitality. If water availability falls below a certain point, the “system” becomes sick – whether it is lack of water for fish or for housing or an industry.

When flow levels are set in rule, the effective date of the rule becomes the priority date – as a water right. Water rights issued after the rule adoption are *junior* to the instream flow and cannot take water unless the flow set in the rule is being met. Setting flows influences water availability for new uses. If a minimum flow is set in a stream, it may restrict development by limiting water available for future out-of-stream uses or it may push the development to other areas where water is available or may increase development of other sources of supply, such as wells.

When the state Water Code was passed in 1917 (Chapter 90.03 RCW), there were about 1.5 million people in Washington state. The Water Resources Act of 1971 (Chapter 90.54 RCW) saw the population at 3.5 million. Population in 2000 is 5.6 million and the state's projected to have 7 million residents by 2010. Hand-in-glove with population growth is a rise in water demand for municipal and domestic uses and for commercial and industrial uses. An example: 8000 new, exempt wells are drilled each year – this is water that could influence stream flows. A recent study has shown that on average 70% of flows in streams during summer comes from ground water. (*Estimated Baseflow Characteristics of Selected Washington Rivers and Streams*: 1999. Water Supply Bulletin No. 60; Department of Ecology. Publication number 99-327. Weblink: http://www.wa.gov/ecology/biblio/99327.html)

Tribes have rights to fish and may also have the right to habitat of sufficient quantity and quality to support fish. Generally, tribes are interested in having enough flow in streams to support harvestable numbers of fish. Tribes have the right to take fish in their "usual and accustomed" fishing places. In a water right context, court rulings have recognized a priority date for Indian instream flow rights associated with treaty fisheries of "time immemorial".

In a current adjudication, the Court ruled that the Yakama Nation's off-reservation instream flow rights exist as an adjunct of the Nation's treaty-secured right to fish in common with the people of the state. Treaty fishing rights are for both anadromous and resident fish. Subsequent rulings **{ }** extended the applicability of the instream flow right to off-reservation tributaries that produce fish contributing to fisheries at numerous sites in the basin for which the Yakama Nation has usual and accustomed fishing rights . The priority date of these rights is "time-immemorial."

Most rights of this nature belonging to the other 19 treaty tribes of Washington State and the two out-of-state treaty tribes with ceded territory in Washington have not been confirmed or quantified by adjudication, however, they likely represent a significant commitment of the water available in streams that support treaty fisheries.

When federal government land reservations were established, water was explicitly or impliedly "reserved" in sufficient quantities and of a quality to support the primary purposes of the reservation. Examples of reserved areas would be Indian reservations, national forests, national parks, wildlife areas, military installations and reservations, and the like. In some areas, these reserved rights are a significant commitment of the available water. The priority date of a federal reserved right is generally the date on which the land reservation was enacted by Congress or established by executive order. For many Indian reservations in Washington, the priority date is in the 1850s. Indian water rights differ from state based water rights in that they are not lost due to non-use and retain their original priority date.

Reserved rights, to the extent they are found to exist, and are quantified for a given reservation are *NOT* subject to relinquishment for non-use and they continue ton exist until the water is needed and put to use. Most water rights are relinquished after five years of non-use.

Endangered and threatened listings of fish stocks under the Endangered Species Act lend an added urgency to providing flows for those fish that are at risk of extinction. As of April of 2000, there are 13 listed salmonid stocks in Washington under the Endangered Species Act. ESA listings can be linked to poor watershed health.

Based on the Governor's Salmon Strategy, *Extinction is Not an Option: A Statewide Strategy to Recover Salmon. (Sometimes called the Statewide Strategy to Recover Salmon or SSRS),*16 of the state's 62 Water Resource Inventory Areas (WRIAs) are classified as over-appropriated basins where stream flows are critical to salmonid recovery. Seven salmon recovery areas have been identified in the State Salmon Recovery Strategy, which cover most of the state. <http://www.governor.gov/esa/> A map depicting over-appropriated basins and the location of at-risk salmonids is in the appendix.

Federal agencies have also assessed the status of fish stocks in Washington and have determined that most of the state has fish that are in jeopardy. The National Marine Fisheries Service (NMFS) website at http://www.nwr.noaa.gov/1salmon/salmesa/specprof.htm has ESA listing information for anadromous fish. The U.S. Fish and Wildlife Service (FWS) has ESA listing information on other species, including bull trout, at http://pacific.fws.gov.

Other factors influence fish besides habitat (which includes flows) - ocean conditions, fish harvest (commercial, sport and tribal), hatchery policy and operations, operation of hydropower and other facilities.

Figure 3
Over-Appropriated Basins Where Flow is Critical to Salmonid Recovery

WRIA 1 Nooksack
WRIA 7 Snohomish
WRIA 8 Cedar-Sammamish
WRIA 9 Duwamish—Green
WRIA 10 Puyallup—White
WRIA 12 Chambers-Clover
WRIA 17 Quilcene
WRIA 18 Elwha—Dungeness
WRIA 32 Walla Walla
WRIA 35 Middle Snake
WRIA 37 Lower Yakima
WRIA 38 Naches
WRIA 39 Upper Yakima
WRIA 45 Wenatchee
WRIA 48 Methow
WRIA 49 Okanogan

Source: *SSRS, 1999*

AUTHORITY FOR SETTING FLOWS

Authority for setting flows is derived from state statutes. The primary statutes relating to flows and setting them are identified following. Rules and laws can be accessed through http://www.wa.gov/ecology/wr/rules/rul-home.html. Case law is not included in this paper but can be accessed at http://www.wa.gov/ecology/wr/caselaw/cl-home.html.

- *Water Code, Chapter 90.03 RCW*, (1917) in section 247 describes Ecology's exclusive authority for setting flows and describes conditioning permits to established flows. It also requires consultation with the Department of Fish and Wildlife, the Department of Community, Trade, and Economic Development,, the Department of Agriculture, and affected Indian tribes on the establishment of minimum instream flows.

- The Minimum *Water Flows and Levels Act* of 1967 (Ch. 90.22 RCW) set forth a process for protecting instream flows through adoption of rules. Among other provisions, it says Ecology must consult with the Department of Fish and Wildlife and conduct public hearings.

- The *Water Resources Act of 1971* (Ch. 90.54 RCW), particularly §020, includes language that says base flows are to be retained in streams except where there are "overriding considerations of the public interest". Further, waters of the state are to be protected and utilized for the greatest benefit to the people and that allocation of water will be generally based on the securing of "maximum net benefits" to the people of the state. This Act also authorizes Ecology to reserve waters for future beneficial uses.

- Chapter 75.20 RCW, *Construction Projects in State Waters*, (1949) requires Ecology to consult with the Department of Fish and Wildlife prior to Ecology making a decision on any water right application that may affect flows for food and game fish. Fish and Wildlife may recommend denial or conditioning of a water right permit.

- The *Watershed Planning Act* (Ch. 90.82 RCW) of 1998 in section 080 specifies that local watershed planning groups can recommend instream flows to Ecology for rule-making and directs Ecology to undertake rule making to adopt flows.

Rule making for flows is done through Ecology's rule-making authority in the Administrative Procedure Act (Ch. 34.05 RCW). Section 90.82.080(1)(ii)(b) of the Watershed Planning Act describes an alternative process using public hearings and notice provided by the county legislative authority.

Federal agencies can be involved in setting flows. Flows can influence water quality (through temperature, dissolved oxygen, and other factors) and are thus related to the Clean Water Act. The Endangered Species Act requires protection for listed species. Water use (such as removing water from streams and thus reducing flows) could have a detrimental influence on listed fish.

Fish and factors affecting them are important to Tribal governments. Tribes have concern with flow levels.

HISTORY

The aforementioned statutes provide for the protection of flows from reduction by subsequent water rights. Case by case water right determinations were made in the 1950s and 1960s that established flow protection levels or denied further appropriation of water to protect flows. Following the 1967 and 1971 Acts until 1986, Ecology established instream flows in seventeen of the state's 62 WRIAs. Since 1985, there has been much controversy over what the level and priority of flows should be. Approaches ranged from Ecology assessing the resource and then establishing rules after comparatively little involvement from those residing within the watershed (as with the proposed Skokomish-Dosewallips rule) to consensus-based techniques (the *Chelan Agreement*). Neither of these approaches resulted in the establishment of instream flow requirements in any watershed in the state. Groups ranging from stakeholders to legislators; proponents of instream use and proponents of out-of-stream use all have had concerns as to how the instream flow program should operate. The upshot of the various efforts has been no instream flows have been set by rule since the Nooksack regulation was adopted (Ch.173-501 WAC) on December 4, 1985.

The Skokomish-Dosewallips Instream Resources Protection Program (WRIA 16) was proposed in 1985. At that time, Ecology rules were reviewed by the Ecological Commission (now defunct). When Ecology proposed instream flows for this basin, the Commission did not endorse the recommended flows and no rule was adopted. The Commission said the flows were too low to adequately protect instream resources. Based on the Commission's determination, Ecology began to re-examine alternative management approaches.

Due to increasing controversy, in 1986, Ecology initiated a full review of the instream flow program and in February of 1987 published the draft environmental impact statement (DEIS) entitled, *Instream Resources and Water Allocation Program Review*. The DEIS included several alternatives ranging from no action, to a pro-development option, to an environmental protection option. It also included the so-called "preferred alternative" which included some aspects of each of the alternatives but, if implemented, would have resulted in major changes in the program and would have increased the level of instream protection for most streams, and required mitigation by any new water developments that would diminish instream values.

This resulted in more controversy and prompted passage of a legislative bill in 1988 (Second Substitute Senate Bill 6724) establishing the Legislature's Joint Select Committee on Water Resource Policy to review the fundamental water resource policies of the state, particularly those related to instream flows and water allocation. This legislative review was no more successful in ending the controversy than Ecology's previous effort.

In 1990, the executive and legislative branches, in cooperation with Indian tribal organizations, initiated a mediated dispute resolution process to address instream flows and water allocation issues. The landmark *Chelan Agreement* of 1991 provided a framework for establishing instream flows and carrying out watershed planning. The Water Resources Forum, which was set up under the Chelan Agreement, developed policy approaches for instream flows and instream flow methodologies but their recommendations remained controversial and were not implemented. The Chelan Agreement established regional pilot water planning programs in the Methow (WRIA 48) and the Dungeness-Quilcene (parts of WRIAs 17 and 18) basins to test a consensus-based approach in local situations. The Regional Planning Guidelines developed by the Forum and the lessons learned formed a basis for later watershed planning legislation that resulted in the current watershed planning programs in Ch. 90.82 RCW.

In 1998, the legislature passed Engrossed Substitute House Bill 2514 which was codified as Watershed Planning, Chapter 90.82 RCW. This chapter provides an avenue for local citizens and various levels of governments to be involved in collaborative water management, including the option of establishing or amending instream flows.

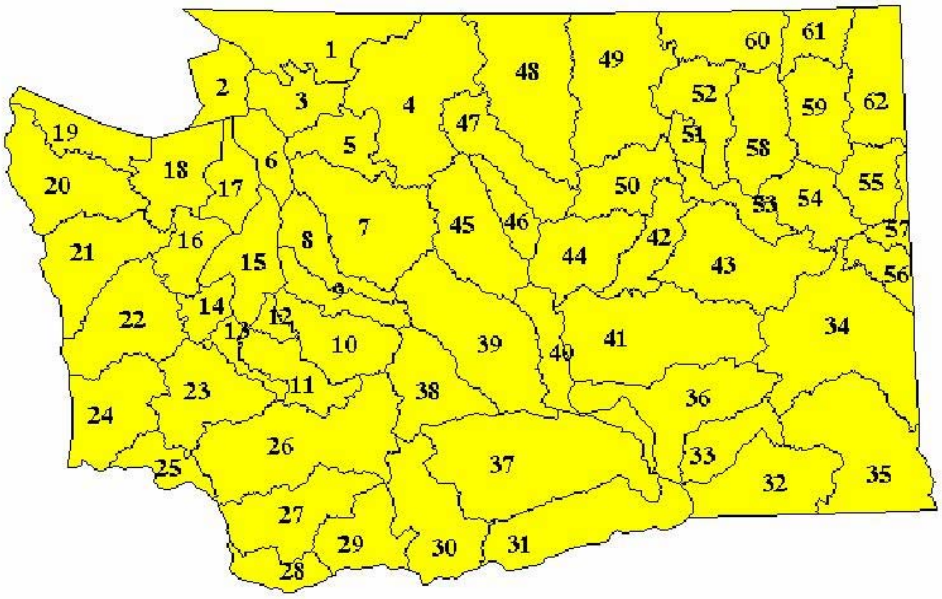
Figure 4: URLs for Major Laws, Regulations and Court Cases relating to stream flows

Washington Water Laws (RCWs)	http://www.wa.gov/ecology/wr/rules/laws-wr.html
Washington Regulations (WACs)	http://www.wa.gov/ecology/wr/rules/rules-wr.html
WA Water-related Case Law	http://www.wa.gov/ecology/wr/caselaw/cl-home.html

STATUS OF FLOWS

Under the Water Resources Act of 1971 (Ch. 90.54 RCW) and its concomitant administrative code (Ch. 173-500 WAC, Water Resources Management Program Established Pursuant to the Water resources Act of 1971), Ecology divided the state into 62 Water Resources Inventory Areas (WRIAs). Based generally on hydrogeographic boundaries, these WRIAs (pronounced "Y-rahs") are the planning and management units for water.

Figure 5: Water Resources Inventory Areas (WRIAs) – Names and Locations



Water Resources Inventory Areas

WAC 173-500-040

1 Nooksack
2 San Juan
3 Lower Skagit-Samish
4 Upper Skagit
5 Stillaguamish
6 Island
7 Snohomish
8 Cedar-Sammamish
9 Duwamish-Green
10 Puyallup-White
11 Nisqually
12 Chambers-Clover
13 Deschutes
14 Kennedy-Goldsborough
15 Kitsap
16 Skokomish-Dosewallips
17 Quilcene-Snow
18 Elwha-Dungeness
19 Lyre-Hoko
20 Soleduck-Hoh
21 Queets-Quinault
22 Lower Chehalis
23 Upper Chehalis
24 Willapa
25 Grays-Elokoman
26 Cowlitz
27 Lewis
28 Salmon-Washougal
29 Wind-White Salmon
30 Klickitat
31 Rock-Glade
32 Walla Walla
33 Lower Snake
34 Palouse
35 Middle Snake
36 Esquatzel Coulee
37 Lower Yakima
38 Naches
39 Upper Yakima
40 Alkali-Squilchuck
41 Lower Crab
42 Grand Coulee
43 Upper Crab-Wilson
44 Moses Coulee
45 Wenatchee
46 Entiat
47 Chelan
48 Methow
49 Okanogan
50 Foster
51 Nespelem
52 Sanpoil
53 Lower Lake Roosevelt
54 Lower Spokane
55 Little Spokane
56 Hangman
57 Middle Spokane
58 Middle Lake Roosevelt
59 Colville
60 Kettle
61 Upper Lake Roosevelt
62 Pend Oreille

Figure 6 WRIAs with Instream Flows &/or Closure Set by Regulation	
WRIA 1 Nooksack	WRIA 14 Kennedy-Goldsborough
WRIA 3 and 4 Lower and Upper Skagit	WRIA 15 Kitsap
WRIA 7 Snohomish	WRIA 22 Lower Chehalis
WRIA 8 Cedar-Sammamish	WRIA 23 Upper Chehalis
WRIA 9 Duwamish—Green	WRIA 45 Wenatchee
WRIA 10 Puyallup—White	WRIA 48 Methow
WRIA 11 Nisqually	WRIA 49 Okanogan
WRIA 12 Chambers-Clover	WRIA 55 Little Spokane
WRIA 13 Deschutes	WRIA 59 Colville

Nineteen Basin Plans or Instream Resources Protection Programs (IRPPs) have been adopted in Washington affecting 19 Water Resources Inventory Areas, the Columbia and the Snake, as well as parts of four other WRIAs.

Some sort of restriction or closure regarding flow is in regulations for 17 WRIAs. This means water use authorized by water rights issued subsequent to the adoption of the instream flows are supposed to be curtailed when the minimum flows in the regulations are not being met. Generally, the flows in the regulations have volume (in cubic feet per second) and/or timing constraints (e.g. the stream may be closed during low flow periods) measured at a flow gage or gages somewhere along the stream. These parameters and any other limitations are spelled-out in the regulations. For an example of flows set in a regulation, examine *Chapter 173-513 WAC, Instream Resources Protection Program – Deschutes River Basin, Water Resource Inventory Area (WRIA) 13*. Section 030 of this WAC lists the gages at which the flows are measured, the flow amounts and the times the specified flow must be in the stream. (Link: Ch. 173–513 WAC)

Flow management has hiostorically been approached through two planning programs, both derived from Chapter 173–500 WAC, the Water Resources Management Program, which was established in response to the Water Resources Act of 1971. Regulations were proposed in each of these planning programs.

The first approach was the “basin management program”. Basin plans attempted a comprehensive view of water resources management within the basin. They included more things than flows. Generally covering only one WRIA each, a basin plan was developed for the Snake River, for the John Day-McNary Pool (parts of WRIA 32, 33, 36, and 37), and for nine other WRIAs.

The second approach, the Instream Resources Protection Program or IRPPs, were narrower in scope and primarily focused on setting flows. Ecology developed most of these in Puget Sound, although IRPPs were also completed for the Columbia and Wenatchee Rivers.

Figure 7
Adopted Basin Plans and Instream Resources Protection Programs

WRIA	Name	WAC Citation	Date filed
WRIA 1	Instream Resources Protection Program Nooksack River Basin	Ch. 173–501 WAC	12/4/85
WRIA 3 and 4	Instream Resources Protection Program -- Lower And Upper Skagit Water Resources Inventory Area (WRIA 3 And 4)	Ch. 173-503 WAC	3/14/01
WRIA 7	Instream Resources Protection Program Snohomish River Basin	Ch. 173–507 WAC	9/6/79
WRIA 8	Instream Resources Protection Program Cedar–Sammamish Basin	Ch. 173–508 WAC	9/6/79
WRIA 9	Instream Resources Protection Program Green–Duwamish River Basin	Ch. 173–509 WAC	6/6/80
WRIA 10	Instream Resources Protection Program Puyallup River Basin	Ch. 173–510 WAC	3/21/80
WRIA 11	Instream Resources Protection Program Nisqually River Basin	Ch. 173–511 WAC	2/2/81
WRIA 12	Instream Resources Protection Program Chambers–Clover Creek Basin	Ch. 173–512 WAC	12/12/79
WRIA 13	Instream Resources Protection Program Deschutes River Basin	Ch. 173–513 WAC	6/24/80
WRIA 14	Instream Resources Protection Program Kennedy — Goldsborough Basin	Ch. 173–514 WAC	1/23/84
WRIA 15	Instream Resources Protection Program Kitsap	Ch. 173–515 WAC	7/24/81
WRIA 22 and 23	Water Resources Program Chehalis RiverBasin	Ch. 173–522 WAC	3/10/76
WRIA 31 and parts of 32, 33, 36, 37	Water Resources Program for John Day–McNary Pools reach of the Columbia River	Ch. 173–531A WAC	6/24/80
WRIA 32	Water Resources Program in the Walla Walla River Basin	Ch. 173–532 WAC	12/14/77
WRIA 45	Instream Resources Protection Program Wenatchee River Basin	Ch. 173–545 WAC	6/3/83
WRIA 48	Water Resources Program in the Methow River Basin	Ch. 173–548 WAC	12/28/76
WRIA 49	Water Resources Program in the Okanogan River Basin	Ch. 173–549 WAC	7/14/76
WRIA 55	Water Resources Program in the Little Spokane River Basin	Ch. 173–555 WAC	1/6/76
WRIA 59	Water Resources Program in the Colville River Basin	Ch. 173–559 WAC	7/22/77
	Instream Resources Protection Program for the main stem of the Columbia River in Washington State	Ch. 173–563 WAC	6/24/80
	Water Resources Management Program for the main stem of the Snake River in Washington State (Expired 7/1/99)	Ch. 173–564 WAC	1/3/93

Instream flows may also be associated with other actions or projects. Hydropower licenses issued by the Federal Energy Regulatory Commission (FERC) may require certain minimum flows be left in a by-pass reach in sufficient quantities to satisfy fish and other instream flow needs. Typically, those flows would be a condition of the FERC license, but may also be required under a state water right and/or a water quality certification issued by the state (Ecology).

Instream flows can be a condition on a new water right in a watershed even where flows have not been adopted by rule. Ecology must solicit comments from the Department of Fish and Wildlife regarding any water right application that may affect food or game fish. Based on DFW comments, Ecology may deny the application or may condition the permit, if issued, with instream flows.

Process for Setting Flows by Rule

In the 1970s and ‘80s when Ecology was actively establishing stream flows by rule, the process can be generally summarized as technical studies followed by policy negotiations, public process, and then rule adoption. A determination of the flows levels needed for instream resources protection was generally based on technical studies. Most of the time the studies focused on fish

Figure 8 **Watershed Planning Areas** **Intending to Address Flows** May 2000
WRIA 1 Nooksack
WRIA 3 Lower Skagit
WRIA 6 Island
WRIA 8 Cedar-Sammamish
WRIA 9 Duwamish-Green
WRIA 13 Deschutes
WRIA 15 Kitsap
WRIA 18 Elwha-Dungeness
WRIA 19/20 Lyre-Soleduck
WRIA 29 Wind-White Salmon
WRIA 30 Klickitat
WRIA 46 Entiat
WRIA 48 Methow
WRIA 56 Hangman Creek
WRIA 59 Colville
All but WRIAs 8 and 9 are Ch. 90.82 RCW planning areas. Some are early in the process and may later determine not to address flows. Other WRIAs may later decide to address flows.

needs, the assumption being in most cases if fish needs are met, the needs for other instream uses would also be met. (An obvious contradiction to this assumption is for recreation such as kayaking where higher flows may be required than are recommended for fish). The Instream Flow Incremental Methodology (IFIM) PHABSIM (**P**hysical **Hab**itat **Sim**ulation system) became and remains the accepted method for most fish-flow studies in the Pacific Northwest. On smaller streams, the so-called "toe-width" method was used to analyze fish habitat flow needs. *(Descriptions of IFIM and toe-width methods are in the appendix.)*

The natural and modified (by human activities) flow characteristics were also typically evaluated. The various interested parties, especially Tribes and the agencies with jurisdiction for fish and other instream resources would meet, usually over the course of several months, and negotiate flow level recommendations. The recommendation usually carried considerable weight in that most of the involved players helped develop the recommendations, supported the recommendations, or at least provided a minority opinion. Ecology then followed rule making procedures specified in the Administrative Procedure Act (and other laws) to propose and eventually adopt the flow protection measures as rules. These procedures typically included public involvement through workshops and advisory committees, and, always, public hearings held in the basins in which the affected streams were located.

Priorities for addressing stream flow issues

Priorities for setting instream flows generally follow the Governor's Salmon Strategy of emphasizing the 16 critical salmon basins. Specifics are listed on the Instream Flow web pages in a document titled: WORKPLAN FOR INSTREAM FLOW SETTING THROUGH 2010.

OBLIGATIONS AND OPTIONS FOR INSTREAM FLOWS

The Water Resources Act of 1971 (Ch. 90.54 RCW) declares the general fundamentals for utilization and management of waters of the state. In addition to the environmental protection measures described previously, §020 includes provision regarding "maximum net benefits" and " overriding considerations of the public interest".

In subsection (2) of §020, the "Allocation of waters among potential uses and users shall be based generally on the securing of the maximum net benefits for the people of the state. Maximum net benefits shall constitute total benefits less costs including opportunities lost." Case law says

Ecology does not have to weigh instream versus offstream uses. Instream flows are a *defacto* higher priority than future offstream use given the language of the statute.

Subsection (3)(a) of §020 says, in essence, that the withdrawal of water which would conflict with the retention of required instream flows can be allowed only in those situations "where it is clear that overriding considerations of the public interest will be served".

This statement would allow an offstream use to be permitted without regard to established instream flows under exceptional circumstances. Similarly, Subsection (3)(b) of §020, the quality of waters of the state cannot be degraded "except in those situations where it is clear that overriding considerations of the public interest will be served".

Watershed Planning Units (WPUs) obligations regarding flows are detailed in Chapter 90.82 RCW, particularly section 080. WPUs have the *option* of recommending flows to Ecology. If the WPU chooses not to address flows or, if the WPU cannot come to a unanimous recommendation on flows, then Ecology may initiate rule making for setting flows that would complete the watershed plan.

The watershed law addresses several planning scenarios. If minimum instream flows have already been adopted by rule for a stream within the management area, those flows shall not be modified unless the members of the local governments and tribes on the WPU unanimously request Ecology to modify those flows. In planning areas where there is no instream flow rule, determination of recommended flows would be a collaborative effort between the WPU and Ecology. Instream flow recommendations must have consensus support of all government members and Tribes and a majority on non-government members of the Planning Unit.

Ecology may adopt the rules either by the regular rules adoption process provided in Ch. 34.05 RCW, the expedited rules adoption process as set forth in RCW 34.05.230, or through a rules adoption process that uses public hearings and notice provided by the county legislative authority to the greatest extent possible.

If there is no Watershed Planning Unit approval of flow recommendations within four years of when funds were first received (under RCW 90.82.040), Ecology may initiate rule making pursuant to Chapter 34.05 RCW and has two years to set flows for those streams for which approval is not achieved.

Section 070 of Chapter 90.82 RCW directs WPUs to assess current water use (which presumably would include flow needs) and develop strategies to meet identified future needs. Assessing flows needed in the watershed's streams and then recommending strategies as to how to protect and/or restore those flows is necessary under the Watershed Planning Act. The WPU recommends flows to Ecology, which is to adopt them into rules under its rule-making authority.

The process for what to do *after* a WPU determines what they believe the flow should be is described in the Watershed Planning Act, RCW 90.82.080. The specific process for how to arrive at a flow recommendation is not prescribed by law.

Watershed Planning Groups Recommending Flows

There are several assumptions underlying the submittal by a watershed planning group of flow recommendations to be made into rules. One is that Ecology and other agencies need to be actively engaged in the development of flow recommendations. Several agencies may have a role (*e.g*. Department of Fisheries and Wildlife has responsibilities for fish which are influenced by

flows) and Ecology has the responsibility for rule development, so its concurrence with the flow levels and the process is crucial. Under the watershed planning law, a planning unit cannot commit an agency to do something with which it has not concurred. Consequently, it is essential that Ecology and the Department of Fish and Wildlife be fully involved in planning unit discussions and decisions on instream flows because both those agencies have responsibilities regarding flows. Belatedly raising issues or opposition to WPU recommended flows would be deservedly criticized by the WPU and the public. Resource agency advice will be given substantial weight for any state commitments to the watershed plan and during rule making (this could include the state Departments of Fish and Wildlife and Health, as well as federal agencies, such as the Environmental Protection Agency (EPA), NMFS, FWS, FERC and possibly others). (See Watershed Planning, Ch. 90.82.130(3) RCW)

Appropriate flow analysis and modeling methodologies will need to be employed. Generally, the Instream Flow Incremental Methodology (IFIM) is recognized as the state-of-the-art method for modeling fish habitat flow needs, particularly for larger streams. IFIM is a process for evaluating instream flows in the context of the entire ecology of the watershed, including hydrology, geography, and biology. PHABSIM is a modeling approach and is a tool for use within (or separate from) IFIM. For smaller streams, the toe-width method may be appropriate. Methodologies for streams within a watershed are a point of negotiation the WPU needs to work through as they develop their flow recommendations. Generally, IFIM is data-intensive and therefore relatively expensive. Toe-width, by contrast, is much less data and time consuming. Both methods require the taking of field measurements during the spring and summer, so timing can be critical. (A brief summary of IFIM and toe-width methods, along with their usual applications, is included in the appendix. See also Appendix B for a list of websites.)

Flow analysis methods for values other than fish would also need up-front agreement. The flow setting process varies from stream to stream. There are, however, some common elements when flows are recommended. Flow needs are identified by an appropriate representation of water users and interested parties, analytical methods are agreed to and data are gathered. Scientists analyze the data and come to an agreement on the flows needed for the various species and life stages of fish (and/or other uses, if they are being analyzed) and make a recommendation to the decision-makers.

When Ecology proposes a rule, including instream flow rules negotiated by a WPU or other local body, it is obligated to follow the Administrative Procedure Act (Ch. 34.05 RCW). (Link to Code Reviser's Office listing RCWs - http://slc.leg.wa.gov/). The APA specifies public hearings. Ecology may adopt rules by the regular rules process or an expedited process (RCW 34.05.230).

The Watershed Planning Act describes an adoption process using public hearings and notice provided by the county legislative authority [RCW 90.82.080(1)(b)].

If the watershed planning effort is sufficiently broad, it should capture most all the views in its flow deliberations. However, during the APA required public hearing(s), information may be brought forth that was not considered during the development of the flow recommendation on which Ecology was to base its rule. Should this happen, Ecology will consult with the watershed planning group prior to taking final action on the rule proposal.

FACTORS TO CONSIDER WHEN ADDRESSING FLOWS

Climate

Climate is a major factor affecting stream hydrology, including flows; particularly precipitation as either rain or snow. The amount and timing of precipitation, and factors related to climate such as vegetative cover and impermeable surfaces, soil and geological conditions, altitude, slope, aspect, and other factors influence flows. Some streams are "flashy" in that they react quickly to rainfall – the rainfall quickly enters the stream and is converted to flow. During the rainy season, flows generally increase (other factors being equal). During hot, dry periods, flows tend to decline to levels at which much of the flow may be the result of ground water discharging into the stream channel or, in watersheds with glaciers, such flows may be a combination of ground water discharge and glacial melt.

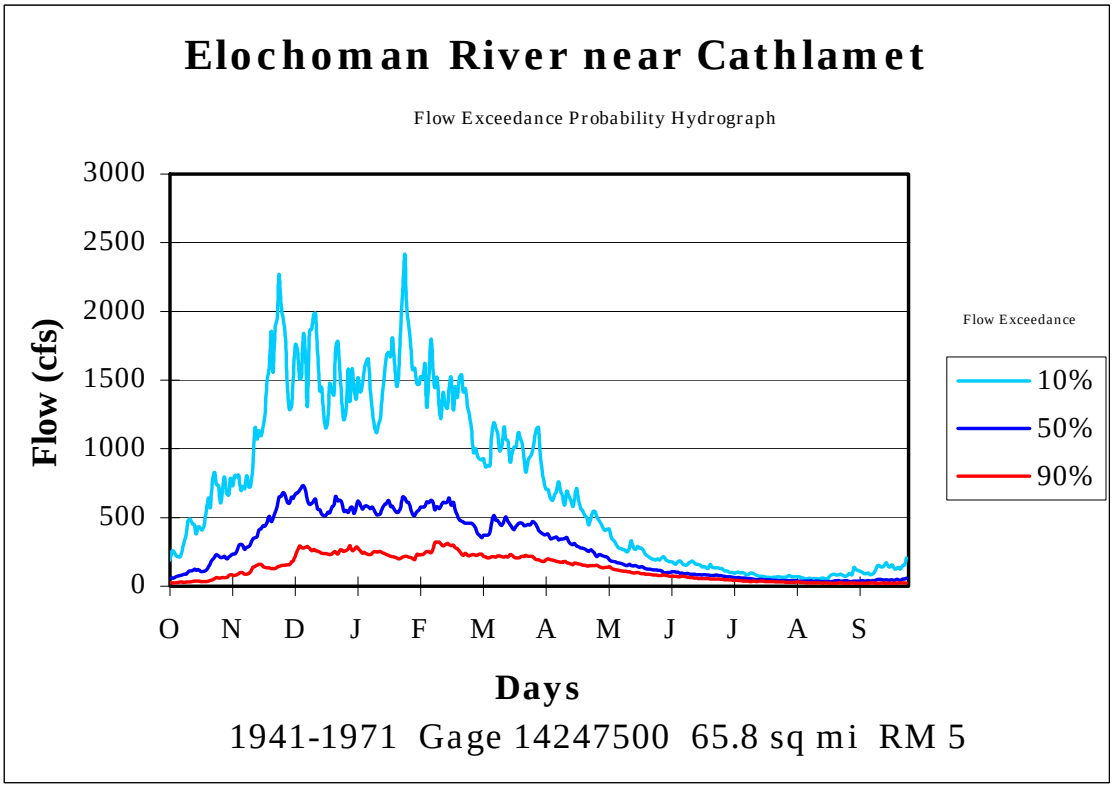


Figure 9: Elochoman River – An Example of a Rain Influenced Stream

The Elochoman River (Figure 9) is an example of a rain-driven system in that the period of relatively high flows is the same as the period of the most rainfall. Lots of rain in the winter yields lots of flow during the winter. Little rain falls during the summer months resulting in very low natural flows.

Snow also influences flow. Lowland snow can cause rapid increases in flow if a warm rain falls on it and causes it to melt; the so –called "rain-on-snow events". At higher elevations, snow melt provides a gradual release of water into streams during the spring as temperatures increase and as the snow melts. Typical of many places in Eastern Washington, flows often peak in late spring and early summer as the warmer temperatures cause melting. Climatic information can be obtained from sources such as a local weather station, airports, USDA Forest Service; the state Department of Natural Resources (DNR), or the National Weather Service. Many sites are available on the web.

The Methow River (Figure 10) is an example of a snowmelt stream. The period of higher flows corresponds to when temperatures start to increase and snow starts to melt; *i.e.* in late spring and early summer. Cold weather during winter months keeps available moisture locked up as snow and ice; causing low flows.

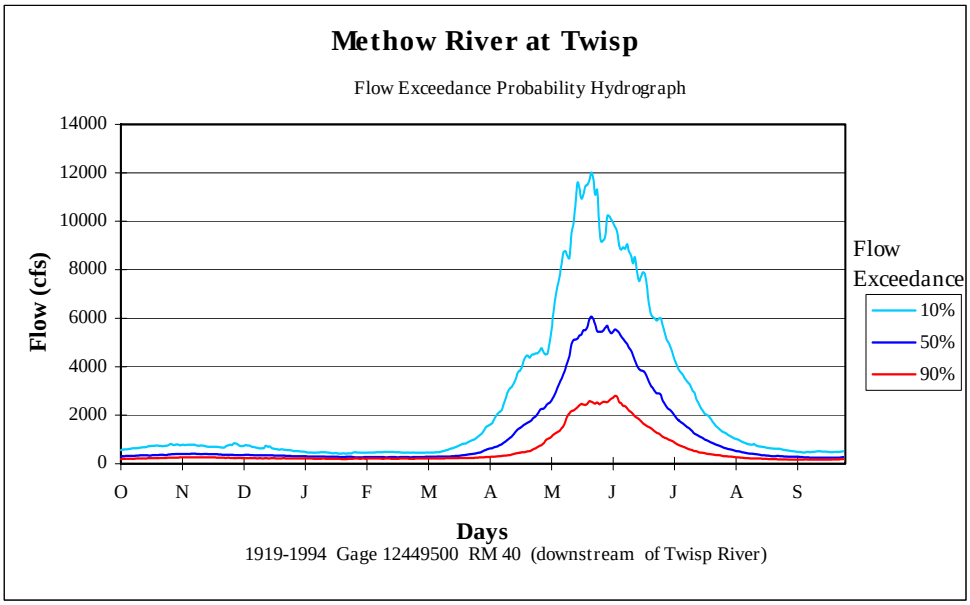


Figure 10: Methow River – An Example of a Snow-Melt Influenced Stream

Drought patterns, El Niño, and La Niña all play a part in flows. Storm events can cause flooding; *i.e.* very high flow. Local flood management agencies and Ecology can provide information on flooding.

Land Use

There is a relationship between flows and vegetative cover. As land is developed, the amount of impervious surface is increased. Water does not penetrate impervious surfaces. Impervious surfaces are things like streets, parking lots, and roofs of buildings. As impervious surfaces increase, streams tend to be "flashier" – the water gets into the streams faster because it runs off of the impervious surfaces instead of infiltrating into the ground and moving more slowly to the streams. Natural vegetative cover tends to "hold" moisture encouraging infiltration into the ground and releases water more slowly than do impervious surfaces. Vegetation also assists in maintaining water quality by "filtering" sediments. Water directed off-site by pipes or ditches also is not available for groundwater recharge. (Stormwater run-off, particularly from streets laced with petroleum originating from motor vehicles, is a water quality concern receiving increased scrutiny.) County and city planning offices are good sources of land use information and the Natural Resources Conservation Service maintains data on rural land uses.)

Ground Water

An October, 1999 study by Ecology (*Estimated Baseflow Characteristics of Selected Washington Rivers and Streams)* (Weblink - http://www.wa.gov/ecology/biblio/99327.html) showed that in the dry season, on a state-wide basis, an average of 70% of streamflow originates from groundwater. Sometimes called, “base-flow”, this groundwater inflow has a significant effect on stream flow. Besides contributing volume to the surface water flow, it generally tends to be colder than surface water, so when it mixes with the surface water it has a cooling effect that is generally beneficial for water quality and salmonids.

Water Use

Water withdrawn from a stream or from a well that is in hydraulic continuity with the stream will not be available for flow in the stream. This can include well withdrawals pulling water directly from the stream or withdrawals from a well intercepting water that would otherwise have moved to the stream. The effect of withdrawals can have a large effect on small streams where the percentage of water withdrawn may be high compared to the water in the stream.

Sidebar 1

Estimated Baseflow Characteristics of Selected Washington Rivers and Streams: Water Supply Bulletin No. 60. October 1999.

ABSTRACT

Automated hydrograph separation techniques were used to evaluate the groundwater contribution to total streamflow (baseflow) at active and inactive stream gaging stations throughout Washington State. Discharge records for 582 gaging stations, with at least three complete water years of daily mean streamflow data, were downloaded from the U.S. Geological Survey (USGS) National Water Information System. Station characteristics were compiled for each gage, including period of streamflow record, type and degree of regulation affecting the gage, watershed drainage area, USGS station number, station name, and gage location.

Summary statistics were calculated for annual mean streamflow and annual 7-day low flow for all 582 stations. Monthly, and in some cases annual, statistics for baseflow were then estimated using a USGS hydrograph separation software program called HYSEP (Sloto and Crouse, 1996) for those stations judged to be free of significant snowmelt or regulation effects.

Annual unit-area baseflow for the 294 stations free of significant regulation or snowmelt effects ranged from <1 to 11 ft3/sec/mi2 with a median value of 2.9 ft3/sec/mi2. Unit-area baseflow for stations located west of the Cascade Mountain crest averaged approximately 3.2 ft3/sec/mi2. Stations located east of the crest averaged approximately 0.4 ft3/sec/mi2. On average, groundwater discharge represented approximately 68% of total annual streamflow for the stations modeled. Estimated groundwater contributions to streamflow for the typical low flow months of July, August, September, and October averaged 86%, 86%, 77%, and 69% respectively. This suggests that reductions in groundwater discharge to streams during this period, due to increased groundwater withdrawals, may significantly impact the instream flows needed to sustain fish and maintain water quality. This highlights the importance of managing surface water and groundwater as a single interconnected resource.

The baseflow estimates provided in this report are best used as basin-scale averages. Any attempt to apply these values as absolute representations of groundwater inflow on either a basin scale or stream segment scale is inappropriate.

Water use patterns and projected future growth play a role in assessing stream flows. Projected future growth includes land use conversions (*e.g.* from forests to development), changes in the amount of impervious surfaces, projected timber harvest, water storage and amounts used; seasonality of use, diversions (ground water withdrawals would also affect flows, depending on the degree of hydraulic continuity, etc.). The planning group should look at long range plans and ascertain if there are major water-using projects being proposed. (Examples would be hydropower

projects, golf courses, municipal supplies, new industries, fruit packers, or any other process or use that is water-based.) In addition, an assessment of how land use alteration may affect future hydrology may provide insight to the flow determination process.

In other cases, the amount withdrawn may have a small effect on a larger river. Water withdrawals tend to diminish peak flows. Affects of that diminishment vary but can cause things like increased out-migration travel times for fish. Planning groups need to carefully assess their specific situation.

Stream flow and water use information can be obtained from the U.S. Geological Survey (see website listing in appendix.), or the state Department of Ecology (from the regional offices), as well as other sources. Withdrawal information (both surface and ground water) can be obtained from the Department of Ecology regional offices. Local government comprehensive plans and water utility Consolidated Water System Plans (CWSPs) can contain valuable information on current and projected water use.

Water diverted or withdrawn can re-renter the hydrologic system downstream from the withdrawal or diversion point. For example, water may be withdrawn for domestic use. After being used in the house, it goes into the septic system and then filters through the ground back into the groundwater, where it then could contribute to base flow in a stream., and if not functioning properly, introduce contaminants into the ground water or hydraulically connected stream.

Dams

Dams affect flows. There are exceptions to the following generalizations. Run-of-the-river facilities basically have the water run through them and have little or no storage capacity. Facilities with storage can control the rate and timing of water released downstream in relation to their size. Dams tend to make for less variation in flows – they diminish the peaks and heighten valleys on a hydrograph. The greater the storage volume, the greater the potential for changes in the flow regime. Rate of flow can vary from hour to hour, depending on the facility. Usually, irrigation storage projects try to store spring run-off and then release it for the summer irrigation season and gradually draw down the water in their reservoirs at a rate that will last the entire irrigation season. Power dams store spring high flows and hold the water until the following winter when power demands are highest (in the Pacific Northwest). Flood control dams briefly capture high flows, then quickly release the water at a safe rate to prepare for the next flood event. Some dams may also store water to augment instream flows during the summer and fall period. Bigger reservoirs can let out more water over a longer period than can a smaller reservoir, other things being equal. Dams can act as sediment traps (trapping sediments behind them) or as barriers to both upstream and downstream fish passage. Because water in a reservoir is slow-moving, sediment tends to “settle out”. In a free-flowing river, the sediment would be transported downstream. Where salmon move down a river system with a number of dams, the amount of time it takes them to reach the ocean may be significantly longer than occurred under natural conditions. Information concerning dams in Washington can be obtained from Ecology’s Regional Offices or Ecology’s Dam Safety Section.

The Federal Energy Regulatory Commission (FERC) licenses hydropower facilities. Oftentimes flows are set as part of a facility’s operating license. Ecology can provide information on these facilities within Washington.

Storage

Storage of water can affect flows. Water storage facilities are those where a structure (like a dam) is placed in a stream and can control the volume and timing of flow. Water may also be stored in

an off-stream reservoir; that is, a reservoir away from the stream course. Water is stored in a reservoir during high flows and then released at times needed to meet the purposes for which the reservoir was built. Usually, water supply reservoirs are filled in the spring and then stored water is gradually released starting in mid-summer to be diverted for various uses. Late summer is generally a time of lower rainfall and lower flows and water released can be used for things such as irrigation for crops. The hydrologic effect is that below the storage facility, the flow does not vary as much as it would naturally between times of high and low flows (The hydrograph would be "flattened" from natural conditions and look much like the 1991 flow depicted, above, in figure 12.)

Artificial recharge, injecting water into the ground, is another approach to storing water for future use. This amounts to using the water holding capacity of the ground as a reservoir. During times when there is excess surface water, it is injected into the ground to be pumped later when it is needed. This pumped water could be put into a stream to increase surface water flow and is called flow augmentation or can be used like water stored insurface water reservoirs.

Future Management

A function of the watershed planning units is to assess current water use and plan strategies for the future. The above factors affecting flow give a snapshot of existing conditions. How flows will be influenced in the future depends on the future being pursued. Planning groups need to look at trade-offs and compromises in their strategies. More development would portend more impervious surfaces, which would result in flashier stream systems. Water retained in the stream could not satisfy out-of-stream uses. A dam might give predictability to flow levels, but would have to address fish passage, as well as a plethora of other related issues (such as nitrogen gas problems, elevated temperatures, fish losing their way during out-migration because they cannot tell which way the water is flowing, increased incidence of disease and stress because the fish "bunch-up" at ladders, etc.). Water withdrawals would reduce the amount of water left for the stream and associated resources.

Other factors

Many factors affecting flow are based on economic and community needs.

Fish and wildlife and their habitat based on flows need to be protected. In state law, RCW 90.22.010 provides that the Department of Fish and Wildlife can request Ecology to establish flows for the purposes of protecting fish, game, birds or other wildlife resources, or recreational or aesthetic values of said public waters whenever it appears to be in the public interest to do so. Traditionally, Ecology has treated requests from Tribal governments in the same way.

In a flow management framework an issue is inchoate rights (unperfected water rights), or other rights that are not in use to the full amount specified. A water right specifies a specific amount of water, where the water will come from, how and where it will be used, and the conditions of use. Sometimes the water right is not "fully exercised". The water right might be for two cubic feet per second (cfs) of flow, but the person may only be using one cfs. Many times the amount of water permitted to be used and the actual use is unknown. This leads to some subjectivity in predicting future water use since the amount *currently* in use is not precisely known. "Paper water rights" may be useful to assess, but normally do not reflect actual use, which tends to be less. In the above example, the "paper right" is for two cfs, but the actual use is only for one cfs. Actual use cannot be truly known until it is measured.

Unauthorized or illegal uses are also a factor influencing water use. There is not a lot of data on illegal uses.

Local water management can affect flows. The number and size of withdrawals, their timing and point of diversion can all affect flow levels. There are more subtle things that may influence future flow conditions such as unperfected water rights, under-or-over-utilized water rights; unauthorized use, and municipal water right reservations, and probably others.

Other planning efforts may be taking place concurrently with a formal watershed planning effort. Watershed analysis is a forestry tool for assessing management influences within a watershed. Different versions of watershed analysis are used by the USDA Forest Service and the Department of Natural Resources to examine some aspects of water management, including stream morphology and hydrology, erosion, fish needs, and water quality. Contact your local Forest Service or DNR office regarding watershed analyses in your area.

Larger and growing water utilities are required to prepare and periodically update water supply plans. Such plans can give a good indication of projected water demand and conservation strategies. The state Department of Health is a good source of information for these plans.

Counties and cities develop growth management and land use plans. Such plans are increasingly linked to the natural resource base (including water) available to support growth and more intensive land use. City, county, and regional planning agencies are the contacts for these plans.

There may be project-specific studies that display flow information (hydropower projects being the most conspicuous example). Any environmental impact statement will examine potential impacts to water resources. Various entities may prepare Habitat Conservation Plans (HCPs) to fulfill ESA needs. HCPs can be done by private industry or government agencies. A limiting factors analysis done under the auspices of HB 2496 could contain flow information.

Special Cases in Flow Management

Cross-boundary Issues. If you are water planning in an area covered by more than one jurisdiction, talk with the jurisdictions in the other part of the area before making decisions or commitments. Upstream activities may influence downstream flows. Washington borders two other states (Oregon and Idaho), plus British Columbia, Canada. All these entities operate under laws that are different from Washington's. The U.S. Clean Water Act and the Endangered Species Act do not apply to Canada, although Canada has comparable approaches. Many rivers cross boundaries which makes for interesting inter-jurisdictional management – an extreme example is the Columbia and its tributaries, which is in British Columbia (Canada), Wyoming, Montana, Idaho, Nevada, Utah, and forms much of the border between Washington and Oregon.

Estuaries. Estuaries are obviously influenced by flows from their streams, but they are also influenced by tides. Special analysis is needed to deduce the relationships in all the flow-related components. A modified IFIM study has been done in the lower Skagit River that considers both flow from the river and tidal influence.

What are the stream flow needs in a watershed?

One way to look at the flow needs in a watershed is to look at needs based on past actions and anticipate the future. Look at physical, biological and economic/social parameters. Ch. 90.54 RCW <http://www.wa.gov/ecology/wr/rules/laws-wr.html> lists what are called the "beneficial uses" of water. WPUs can look at these uses and ascertain which need to be addressed in the planning area. The list of beneficial uses is: domestic, stock watering, industrial, commercial, agricultural, irrigation, hydroelectric power production, mining, fish and wildlife maintenance and enhancement,

recreational, and thermal power production purposes, and preservation of environmental and aesthetic values, and all other uses compatible with the enjoyment of the public waters of the state. The discussion following addresses how flows might relate to various uses in a general way.

A good way to start is with a scoping process. Scoping is a first step in watershed planning under Chapter 90.82 RCW after a planning process in initiated. This is the time to determine whether instream flows will need to be addressed in the assessment and the planning process, how information will be collected and analyzed, and who will do the technical work required to address stream flows. If instream flows have previously been established, the initiating governments must decide whether the existing flows will be reevaluated for possible amendment. Lead-time for work-planning is necessary if flow studies are needed. More than one watershed area may need flow studies. Such studies can generally only be conducted during certain parts of the year when flows are at appropriate levels and are relatively stable. Generally, for determining fish habitat, measurements need to be taken over a range of flows (generally at high, medium, and low flows). Ecology is researching numerous existing instream flow studies and is preparing a data base of them for use by WPUs and others.

Fish

Fish in danger of extinction need protection. Currently, listing of fish stocks under ESA is an important factor – particularly where there is a direct link between flows and the listed fish. Streams need to have enough water in them to avoid a "take" of listed fish under ESA. Further (and this concept will be discussed in more detail later), the National Marine Fisheries Service is requiring what they are calling "target" flows" which they believe are biologically achievable, based on science, are restorative for fish runs, and may be imposed on existing state-issued water rights. Federally mandated target flows are not based on state water law.

There are numerous documents with fish-flow and related information. One such document that gives much fish and flow information is the 1992 *Salmon and Steelhead Stock Inventory* (available on the DFW website - http://www.wa.gov/wdfw/recovery.htm), ESA listings and recovery documents from the federal agencies (websites listed in appendix) are sources of fish and flow information, as are Indian Tribes. While not basin specific, the Governor's Statewide Strategy for Recovery of Salmon suggests alternative strategies for protecting and restoring flows.

Water Quality

Water quality and flows are related. Section 303(d) of the Clean Water Act requires the listing of water bodies not meeting water quality standards. Ecology listed 49 streams in 1998 under §303(d) because flows are inadequate to support designated instream water uses, such as fish. These streams are generally expected to be addressed in the future through the establishment, protection and restoration of stream flows. The §303(d) list can be found on Ecology's website at http://www.wa.gov/ecology/wq/303d/.

Questions to be asked related to water quality and flows are: Are streams §303(d) listed due, in whole or in part, to low flows? Are there Total Maximum Daily Loads (TMDLs) – water clean-up plans - in your basin that have a low flow component? What would be the impact of reduced flows on concentrations of pollutants? Are there waste discharge permit holders open to buying water to increase flows and thereby increase loading capacity? The Water Quality Program in the Ecology regional offices can provide much information on these aspects for watershed planning.

Cultural and Aesthetic

Are there cultural or aesthetic values in your watershed that need attention? The needed amount of flow may be more subtle than having adequate water for fish or dilution capacity. Cultural and aesthetic values need to be considered. For example, Snoqualmie Falls is a sacred place to some native Americans. Flows over the Falls may need to be protected to protect religious rights. Scenic stream reaches may also require flows to retain aesthetic values.

Recreation

High flows may be required at some times of the year to provide recreational boating flows – *i.e.* kayaking and rafting. The National Park Service has prepared a publication describing concepts and research methods for assessing flows for recreation.[2]

Sidebar 2 - A HYPOTHETICAL EXAMPLE of Water Right Relationships

Farmers hold water rights for withdrawing water from a stream. Farmer Brown has a water right dated 1899 for three cfs. Farmer Jones has a water right from 1929, also for three cfs. Smith has one dated 1954 for five cfs. An instream flow rule was adopted in 1975 that would keep 75 cfs in the stream to protect instream values. Farmer Green has a 1982 water right for 10 cfs.

In wet years, when the stream flows are high, there is enough water to supply all the withdrawals and the instream flows.

3 cfs for Brown
3 cfs for Jones
5 cfs for Smith
75 cfs for the instream flow
10 cfs for Green.

But then in a dry year, there may not be enough water to satisfy all those with valid water rights. Brown gets his 3 cfs; then Jones gets hers, then Smith, then the minimum flow and then Green. Who gets water depends on their priority date – the date of their water right and the amount of water available. In water management jargon, Green's water right would be "junior" to all the others; and Brown's would be the most "senior". Whether or not Green would get his water would depend on the amount of water available in a given year or season (*i.e.* if it is a wet or a dry year). Under current state law, there is "np sharing the burden"; *i.e*. the most junior user is curtailed, then the next most junior, *etc*. until the next most junior's use is satisfied.

POLICY CHOICES

The environmental effects of flow setting need to be analyzed. Many watershed units around the state involved in Ch. 90.82 RCW planning have indicated they want to recommend flows. Other planning groups may defer to Ecology for determining appropriate flow levels

The Current Situation

As mentioned previously, 17 of the 62 WRIAs have had flows established by rules. Many existing instream flows, currently adopted in state rules, were not designed or intended to be met at all times every year. Fish are opportunistic. They will take advantage of high flow years to spawn and rear in areas that may not be available in normal or dry years. They need to the good years (years with high flows) to sustain the run through the dry years. This is one reason why flows were set that may not always be there under natural conditions. Instream flows under state law are regarded as a water right under the prior appropriation doctrine. The prior appropriation doctrine is summarized in the statement "first in time is first in right". In terms of flow, what this means is that whomever first obtained a valid water right for the use of the water, has a higher priority for using that water than someone establishing a water right with a later date. If flows should diminish to a point where all holders of water rights could not be satisfied, the person with the oldest (most senior) water right would get water prior to those with a later water right date (a later "priority date").

[2] Whittaker, D. et. al. 1993. *Instream Flows for Recreation: A Handbook on Concepts and Research Methods*. Available from the Alaska Region of the National Park Service; 2525 Gambel Street; Anchorage, AK 99503. 104 pp., illus.

Instream flows were established to protect instream resources, including fish. Fish take their turn under the water right priority system. Current law talks about preserving and protecting flows to protect instream resources.

If the stream flows in a river are mostly adequate to meet the needs of fish and other instream values, then the existing approach to setting instream flows will serve to preserve these existing stream flows for fish and other instream values in the future. Strategies to ensure that the instream flows are met can be designed and included in a watershed plan for that river. Instream flows established for rivers where existing stream flows are adequate to protect instream values have been referred to as "preservation flows".

The Watershed Planning Act requires watershed plans to include strategies to ensure sufficient water to meet instream flows. However, watershed planning units trying to identify these strategies are likely to find that existing state instream flows cannot be met with a high degree of certainty. Any new instream flows adopted under the existing state system would also be very difficult to meet on a constant basis.

Offstream water users with water rights that are senior to the instream flow rules are authorized to use water even when the instream flows are not being met. Even without water use, climate alone will cause variability in stream flows that do not meet the adopted instream flows in some years or seasons. When instream flows were adopted, it was recognized that these adopted flows would not be met every year.

Sidebar 3: Emphasis of Current Laws on Protection and Preservation

RCW 90.54.020

(3) The quality of the natural environment shall be ***protected*** and, where possible, **enhanced** as follows:

(a) Perennial rivers and streams of the state shall be retained with base flows necessary to provide for ***preservation*** of wildlife, fish, scenic, aesthetic and other environmental values, and navigational values. (***Emphasis added.)***

RCW 90.22.010

The department of ecology may establish minimum water flows or levels for streams, lakes or other public waters for the purposes of ***protecting*** fish, game, birds or other wildlife resources, or recreational or aesthetic values of said public waters whenever it appears to be in the public interest to establish the same. In addition, the department of ecology shall, when requested by the department of fish and wildlife to ***protect*** fish, game or other wildlife resources under the jurisdiction of the requesting state agency, or if the department of ecology finds it necessary to ***preserve*** water quality, establish such minimum flows or levels as are required to ***protect*** the resource or ***preserve*** the water quality described in the request or determination. (***Emphasis added.)***

This issue is also particularly important in basins with fish species listed as endangered or threatened. Where stream flows are limiting to the recovery of listed fish, the federal agencies responsible for the Endangered Species Act have emphasized the need to set

instream flows that can be achieved with a high degree of certainty. They have also emphasized that instream flows need to be biologically-based and sufficient to ensure recovery and survival of listed fish. The term "target flow" has been affiliated with ESA and other federal programs that are pursuing adequate stream flows for fish. Such flows are based on federal law rather than state law. However, there are strategies under state law that can help restore depressed or inadequate stream flows. These include water conservation, lease or purchase of water, enforcing illegal and excessive use, and water measurement requirements.

There may be authority, as yet untested, for the state to set restoration flows under the Water Resources Act of 1971 (Ch. 90.54 RCW). That statute says, in 020(3) "The quality of the natural environment shall be protected and, where possible, enhanced as follows: (a) Perennial rivers and streams of the state shall be retained with base flows necessary to provide for preservation of wildlife, fish, scenic, aesthetic and other environmental values, and navigational values. (Emphasis added.) This language seemingly allows Ecology to establish a restoration flow (goal) by rule.

The Governor's Statewide Strategy for Recovery of Salmon refers both to protection of existing stream flows where they are adequate to meet the needs of salmon, and restoration of stream flows where flows are not currently adequate. For rivers where the existing stream flows are not adequate to meet the needs of fish, a "preservation" or "protection" flow would not be an effective approach from a state water rights perspective, because the water would already have been removed from the stream. Rather, a "restoration" flow would be the primary objective for setting and achieving instream flows, because there a quest for ways to actually restore or re-establish water back into the stream.

The obligation to meet instream flows through the watershed plan or to meet ESA requirements is compelling the state and watershed planning units to take a different approach to setting and achieving instream flows. If a river currently has enough water to meet instream needs, a traditional "preservation" or "protection" instream flow may suffice. If a river does not currently have adequate stream flows, a "restoration" flow would need to be set; one that can be achieved.

Instream flow rules adopted as a result of watershed plans, or salmon recovery plans, could actually have two different flow rates - an instream flow for preservation purposes that is only achieved during wetter years and only affects junior water rights, and another instream flow that is expected to be met most of the time and for which strategies are in place to ensure they are achieved.

An extremely difficult and thorny issue exists in those circumstances where streams have been over-allocated; that is, where the state has issued water rights and those water rights are being legally exercised under state law. The problem is that in some streams when the holders of those valid water rights use those rights, there is not enough water left in the stream for ESA listed fis (or other resources, for that matter.) ESA does not recognize state water rights – it is interested in having habitat for fish, including sufficient flows. Reconciling ESA and state water law is a difficult issue.

Guide to Instream Flow Setting in Washington State

Ecology has developed " A Guide to Instream Flow Setting in Washington State" (see instream flow web page) to assist local planning groups in addressing instream flow issues. It discusses statutory requirements, assessing instream flow needs, developing instream flow recommendations and the rule-making process as applied to instream flows.

Water Vision

In a related action, the state has been developing a new concept for instream flows. The Governor sent a letter in early 2000 to the leadership of the state Legislature defining a preferred future for water resources management in Washington. Four concepts are described in the letter:

- Natural resource base
- A water market
- Information-based management
- Shared governance

Still under development, the draft "A Water Resources Vision – a preferred future for water resource management in Washington State" includes the above elements as cornerstones for moving forward with water management. < http://www.wa.gov/ecology/wr/plan/vis-stat.html >

The draft definition for the natural resource base is "adequate water quantity and quality to ensure a healthy, properly functioning watershed." This concept is closely related to the idea of stream flows that must be met with a high degree of certainty. Instream flows derived for this concept could vary from year to year to reflect weather and other natural conditions but would provide sufficient water to meet aesthetic, recreational and other needs, as well as biological requirements on a watershed basis.

Part of the vision is to establish a water market where willing buyers and willing sellers of water can get together. This market could eventually replace the allocation and permit system and would be governed by rules to ensure equity and address any impairment. Basic family needs for water could be subsidized.

Information-based water management would hinge on monitoring of water conditions, including the measurement and reporting of water use. The information would be readily available for those in the water market. Water rights would be clearly defined and fully adjudicated. Development of this system will take time.

Washington is already moving in the "shared governance" direction – local governments are becoming increasingly involved in watershed planning and management and water rights, and would be involved in the water market. Water management responsibilities would be divided to those governments where administration and management would work best. The state would continue to oversee the natural resource base, in conjunction with tribal, federal and other state agency partners, but with substantial local involvement.

Watershed planning units are encouraged to have an early and in-depth discussion of the above ideas as they relate to instream flow and other needs in their watershed. These concepts are incorporated into the draft Water Resources Vision < http://www.wa.gov/ecology/wr/plan/vis-stat.html>.

How the Flow Setting Process Works

The roles of the planning groups and of Ecology for flow setting are described in Chapter 90.82.080 RCW. Planning unit and Ecology responsibilities vary depending on the specific circumstances, but basically the WPUs and Ecology work together to develop flows and then Ecology undertakes rule making to adopt flow rules.

When Ecology proposes a rule, there are specific steps it goes through. (There is a link to the Ecology's Rules Unit at http://www.wa.gov/ecology/leg/laws-etc.html describing Ecology's process and a link from there to the Code Reviser's Office, which describes the legal basis and procedures.) Simply put, Ecology would take the flows recommended by the planning group, and file a Preproposal Statement of Inquiry (CR-101) with the Code Reviser's Office. This notice says, in effect, that a rule making proposal is being contemplated. Rule language and supporting documentation would then be developed, including environmental and economic analyses. Entities with an interest would be consulted (much of this would probably have already occurred during watershed planning). The Watershed Planning Act (Ch. 90.82 RCW) stipulates that a small business economic impact statement is not required for rules developed under that system.

In areas not involved in watershed planning, Ecology would hold public workshops on instream flows and could establish a public advisory committee. Consultations with fisheries agencies and tribes on technical issues would be held.

Filing a Notice of Proposed Rule Making (CR-102; also filed with the Code Reviser's Office) is the next step. This filing starts the rule promulgation clock. (The agency has 180 days to adopt, withdraw or extend the rule proposal.) This notice is followed by a public review and comment time – workshops and hearings are held and an explanation is compiled of what the public said about the proposal. Agency management would be briefed and the environmental analysis and rule language finalized.

After the public has commented and the analysis is completed, the Director of Ecology would then decide whether or not to issue the Rule Making Order (CR-103). The rule order includes a date when the rule goes into effect and it is published in the *State Register*.

If issues are raised during the public comment period of Ecology's rule making; Ecology will go back to the watershed planning group for consultation.

Ch. 90.82 RCW that says Ecology can establish rules based on the planning units recommendations ". . . or through a rules adoption process that uses public hearings and notice provided by the county legislative authority to the greatest extent possible." The statute is not clear on what this means if this option is pursued. As watershed planning groups under Ch. 90.82 RCW draw near rule development, the roles and responsibilities of those involed needs to be sorted.

State agencies besides Ecology may be involved in the watershed planning process. The relationships are described in the state agency MOU[3] on watershed planning. (See the following website for information on the MOU between state agencies for Watershed Planning: http://www.wa.gov/ecology/watershed/MOU.html.) Generally, the Department of Fish and Wildlife will be heavily involved in determining and recommending flows since Chapter 90.22 RCW says the Department of Fish and Wildlife may request Ecology to set flows to protect fish, game and other wildlife resources.

[3] Memorandum of Understanding For the Coordinated Implementation of Chapter 247, Laws of 1998: Watershed Management (Engrossed Substitute House Bill 2514), and Chapter 246, Laws of 1998: Salmon Recovery Planning (Engrossed Substitute House Bill 2496), By the Participating Agencies Of the State of Washington: The Department of Agriculture, The Conservation Commission, The Department of Community, Trade, and Economic Development, The Department of Ecology, The Department of Fish and Wildlife, The Department of Health, The Department of Natural Resources, The Department of Transportation, The Interagency Committee for Outdoor Recreation, The Puget Sound Water Quality Action Team, The Salmon Recovery Office, Within the Governor's Office, and, The State Parks and Recreation Commission,

The state Departments of Health, and Community, Trade and Economic Development may be involved in watershed planning, particularly if there are issues related to economic development and water supply (as well as others). The Interagency Committee for Outdoor Recreation (IAC) may be involved due to their role as administrators of the Salmon Recovery Funding Board. The Department of Natural Resources may have an interest in flows depending on the specific situation. The Department of Agriculture may be involved to the extent plan recommendations affect agricultural activities in the WRIA.

Several Ecology programs could be involved with instream flows, depending on the circumstances. Following is a thumbnail sketch of potential interest from Ecology programs regarding instream flows. Instream flows rules are developed by Ecology's Water Resources Program. Besides rule making, Water Resources would be interested in ground and surface water management, water rights administration, and dam safety, among others. The Water Quality Program would be interested in water quality issues. The Environmental Investigations Program would be interested monitoring and studies. The Shorelands and Environmental Assessment program would be involved in shorelines and wetlands issues, watershed management, and State Environmental Policy Act compliance.

Assistance

Instream flow information is available through the web at Ecology's Water Resources webpage <http://www.wa.gov/ecology/wr/wrhome.html>. Through the Ecology watershed lead, information is available on the policy and technical aspects of flow setting. Policy assistance would include such things as an overview of flows, what the laws say, how flows are administered in Washington, how to turn flow recommendations into rules, etc. Technical assistance could cover such things as what studies are needed, what studies have been done in a particular watershed, analysis and interpretation of data and studies; description of what studies would be appropriate under what conditions, and how to make the most of funds as applied to flow studies and information gathering.

The watershed lead can arrange for Ecology and/or Department of Fish and Wildlife staff specialists on instream flows to advise and assist watershed planning units and other watershed groups.

APPENDIX A

Websites

The websites listed below have information and links related to stream flow. It is not an exhaustive list, but a list to get one started. Tribes, environmental groups, and consulting firms also have information related to flows and water management.

LOCAL AGENCIES

Conservation Districts (Access via Conservation Commission's website)	http://www.conserver.org/index.shtml	Agriculture, stream restoration, technical assistance

STATE AGENCIES

Code Reviser's Office	http://slc.leg.wa.gov/	All state laws and regulations
Department of Ecology	http://www.wa.gov/ecology/	Agency's home page –links to programs
SEPA	http://www.wa.gov/ecology/cp/sepa/e-review.html	State Environmental Policy Act compliance
Shorelands	http://www.wa.gov/ecology/sea/shorelan.html	Shorelands & wetlands
Watershed Planning	http://www.wa.gov/ecology/watershed/index.html	Info on grants, planning activities
Water Quality Program	http://www.wa.gov/ecology/wq/wqhome.html http://www.wa.gov/ecology/wq/303d/	WQ standards, 303(d) streams for low flows; TMDLs, more
Water Resources Program -	http://www.wa.gov/ecology/wr/wrhome.html http://www.wa.gov/ecology/wr/rules/rul-home.html	General water resources Policies, Rules, Laws & Case Law
Department of Fish and Wildlife	http://www.wa.gov/wdfw/recovery.htm	Salmon recovery & management
SASSI 1992 Salmon and Steelhead Stock Inventory	http://www.wa.gov/wdfw/fish/sassi/sassi.htm	Salmonid inventory
Governor's Office	http://www.governor.wa.gov/esa/	September 1999, Extinction *is Not an Option: A Statewide Strategy to Recover Salmon. (Sometimes called the Governor's Salmon Strategy or SSRS).* *Many links.*
Department of Health	http://www.doh.wa.gov/	Water supply planning; drinking water
Department of Natural Resources (DNR)	http://www.wa.gov/dnr/	Watershed Analysis
Salmon Recovery Funding Board (within the Interagency Committee for Outdoor Recreation)	http://www.wa.gov/iac/index.html	Funding for salmonid projects

FEDERAL and TRIBAL AGENCIES

Army Corps of Engineers (COE)	http://www.nwd.usace.army.mil/ps/	Fish Management Division. Responsible for operation of some dams
Bonneville Power Administration (BPA)	http://www.bpa.gov/indexmain.htm	
Environmental Protection Agency (EPA)	http://www.epa.gov/OW/	Office of Water – all water quality aspects
Federal Energy regulatory Commission (FERC)	http://www.ferc.fed.us/	Hydropower licensing & related environmental analyses
U.S. **Fish and Wildlife Service (Pacific Northwest Region)**	http://pacific.fws.gov/	ESA for non-anadromous fish (*e.g.* bull trout) and other
U.S. **Geological Survey** (USGS)	http://iwww.mesc.usgs.gov/sre/sre.html	Water information and measurement methodologies. Instream Flow Incremental Methodology (IFIM)
National Oceanographic and Atmospheric Administration (NOAA)	http://www.noaa.gov/	Fisheries, weather
Natural Resources Conservation Service (NRCS)	http://www.nrcs.usda.gov/	Agriculture; best management practices; stream restoration. Formerly SCS.
Northwest Indian Fisheries Commission (NWIFC)	http://www.nwifc.wa.gov/	Fisheries planning & issues
Northwest Power Planning Council (NWPPC)	http://www.nwppc.org/welcome.htm	Fish & wildlife issues as impacted by power planning

APPENDIX B

Instream Flow Study Methods used in Washington

The three instream flow study methods described below are the primary flow measurement methods used in Washington state for fish habitat analysis. IFIM and toe-width are the methods used most often. An instream flow primer along with a description and comparison of toe-width and IFIM can be found at <http://www.ecy.wa.gov/programs/wr/sw/inst.html>. The Tennant method is not used frequently in Washington.

Methods are available to determine flow levels for other uses (see Whittaker, D. et. al. 1993. *Instream Flows for Recreation: A Handbook on Concepts and Research Methods*. Available from the Alaska Region of the National Park Service; 2525 Gambel Street; Anchorage, AK 99503. 104 pp., illus.).

The Washington Department of Fish and Wildlife and the Department of Ecology have prepared a document entitled, “Instream Flow Study Guidelines: Technical Habitat and Suitability Issues” (see instream flow web page). It discusses technical issues including flow studies, biological and physical requirements as well as coordination.

Instream Flow Incremental Methodology (IFIM) and Physical Habitat Simulation (PHABSIM)

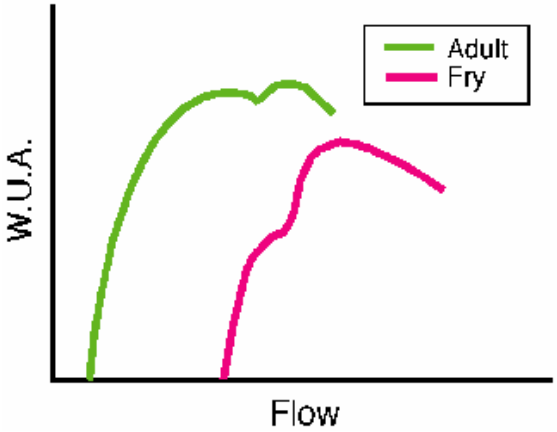
IFIM is a process for evaluating instream flows in the context of the entire ecology of the watershed, including hydrology, geography, and biology. PHABSIM is a modeling approach and tool for use within (or separate from) IFIM. The models are in PHABSIM. IFIM generally is selected as the best available method for predicting how the quantity of available fish habitat changes in response to incremental changes in streamflow. The U.S. Fish and Wildlife Service in the late 1970s (Bovee, 1982) developed this methodology. The IFIM involves putting site-specific streamflow and habitat data into a group of models collectively called PHABSIM (physical habitat simulation). Within IFIM are models of fish habitat as affected by hydraulics. The most common hydraulic model is IFG4, which uses multiple transects (stream cross-sections) to predict depths and velocities in a river over a range of flows. IFG4 creates a cell for each measured point along the transect or cross-section. Each cell has an average water depth and water velocity associated with a type of substrate or cover for a particular flow. The cell's area is measured in square feet. Fish habitat is defined in the computer model by the variables of velocity, depth, substrate, and/or cover. These are important habitat variables that can be measured, quantified, and predicted.

The IFIM is used nationwide and is accepted by most resource managers as the best available tool for determining, in a broad sense, the relationship between flows and fish habitat. However, the methodology only uses four variables in hydraulic simulation. At certain flows, such as extreme low flows, other variables such as fish passage, food supply (aquatic insects), water quality, competition between fish species, and predators (birds, larger fish, etc.) may be of overriding importance. In addition to the PHABSIM models, IFIM may include reviewing water quality, sediment, channel stability, temperature, hydrology, and other variables that affect fish production. These additional variables are not analyzed in this report. They can be analyzed in the IFIM/PHABSIM process, but in Washington the typical approach has been to use depth, veolcity, and substrate.

After the IFG4 model is calibrated and run, its output is entered into another model (HABTAT) with data describing fish habitat preferences in terms of depth, velocity, substrate, and cover. These

preferences vary according to fish species and life-stage (adult spawning and juvenile rearing), as well as reach to reach and from stream to stream.

The output of the HABTAT model is an index of fish habitat called Weighted Useable Area (WUA). The preference factor for each variable at a cell is multiplied by the other variables to arrive at a composite, weighted preference factor for that cell. For example: a velocity preference of 1.0 multiplied by a depth preference of 0.9, then multiplied by a substrate preference of 0.8 equals a composite factor of 0.72 for that cell. This composite-preference factor is multiplied by the number of square feet of area in that cell.



A summation of all the transect cells' areas results in the total number of square feet of preferred habitat available at a specified flow. This quantity is normalized to 1,000 feet of stream or river. The final model result is a listing of fish habitat values (WUA) in units of square feet per 1,000 feet of stream. The WUA values are listed with their corresponding flows (given in cubic feet per second). A WUA/flow relationship is produced for each fish species and lifestage of interest.

This graph shows a hypothetical relationship between weighted usable area (WUA, the wetted area of a stream weighted by its suitability for use by fish) and various flow levels. The graph shows that with more flow, up to some point where the curve breaks, the more flow in the stream; the more habitat.

All the information generated by the model must be evaluated by biologists together with information on actual stream flows to derive instream flow recommendations. IFIM output is not "the answer", but rather an evaluation tool for analyzing the habitat protected by various levels of flow.

Reference

Stalnaker, Clair, *et. al*. 1995. The Instream Flow Incremental Methodology: A Primer for IFIM. USDI, National Biological Service, Biological Report 29. 44 pp.; illus.

Toe-Width Method

The Toe-Width Method was developed by the former Department of Fisheries (WDF), the former Department of Game (WDG), and the U.S. Geological Service (USGS) in the 1970s at the request of the state legislature in response to the need to determine minimum instream flows for fish. After the legislature passed the Minimum Water Flows and Levels law in 1969 and the Water Resources

Act of 1971, USGS collected water depths and velocities along transects over known spawning areas. WDF and WDG provided the criteria for salmon and steelhead spawning and rearing and the locations of the known spawning areas. After 9 years of data collection, USGS had measured 28 streams and rivers in eastern and western Washington numerous times. They had 84 study reaches with each reach consisting of four transects. They measured each transect at 8 to 10 different flows. USGS used the data from these 336 transects to calculate preferred spawning and rearing flows for salmon and steelhead. Criteria for the preferred spawning and rearing depths and velocities for each fish species and lifestage were used to calculate the square feet of habitat at each measured flow. These points of habitat quantity at different flows were connected to create a fish habitat versus streamflow relationship. In this sense, the data collected and the information developed was similar to that provided by an IFIM study today. In fact, the USGS method was a precursor to the IFIM.

Next, these fish habitat relationships were compared to many different variables in the watershed to determine if there were any correlations that could be used to avoid having to do so many flow measurements to calculate a spawning or rearing flow for a certain fish species. The toe-width was the only variable found to have a high correlation. The toe-width is the distance from the toe of one streambank to the toe of the other streambank across the stream channel. This width of the stream is used in a power function equation to derive the flow needed for spawning and rearing salmon and steelhead.

References

Swift, C.H. III. 1979. Preferred Stream Discharges for Salmon Spawning and Rearing in Washington. USGS Open-file Report 77-422. Prepared in cooperation with the State of Washington Department of Fisheries. 51 pp.; Illus.

Swift, C.H. III. 1976. Estimation of Stream Discharges Preferred by Steelhead Trout for Spawning and Rearing in Western Washington. USGS Open-file Report 75-155. Prepared in cooperation with the State of Washington Department of Game. 50 pp.; illus.

Tennant Method

Don Tennant developed this methodology and recommends flows based on average flow. It is sometimes called the “Montana” method. Using USGS data, this method is based on aquatic habitats being very similar when they are carrying the same proportion of the average flows. Ten percent of the average flow is a minimum instantaneous flow recommended to sustain short-term survival habitat for most aquatic life forms. Thirty percent is recommended as a base flow to sustain good survival conditions for most aquatic life forms and general recreation. Sixty percent provides excellent to outstanding habitat for most aquatic life forms during their primary periods of growth and for the majority of recreational uses.

In general, this method is not used in Washington. In a large river, it can be useful in developing a quick response, such as for evaluating potential impacts from a water right application.

Reference

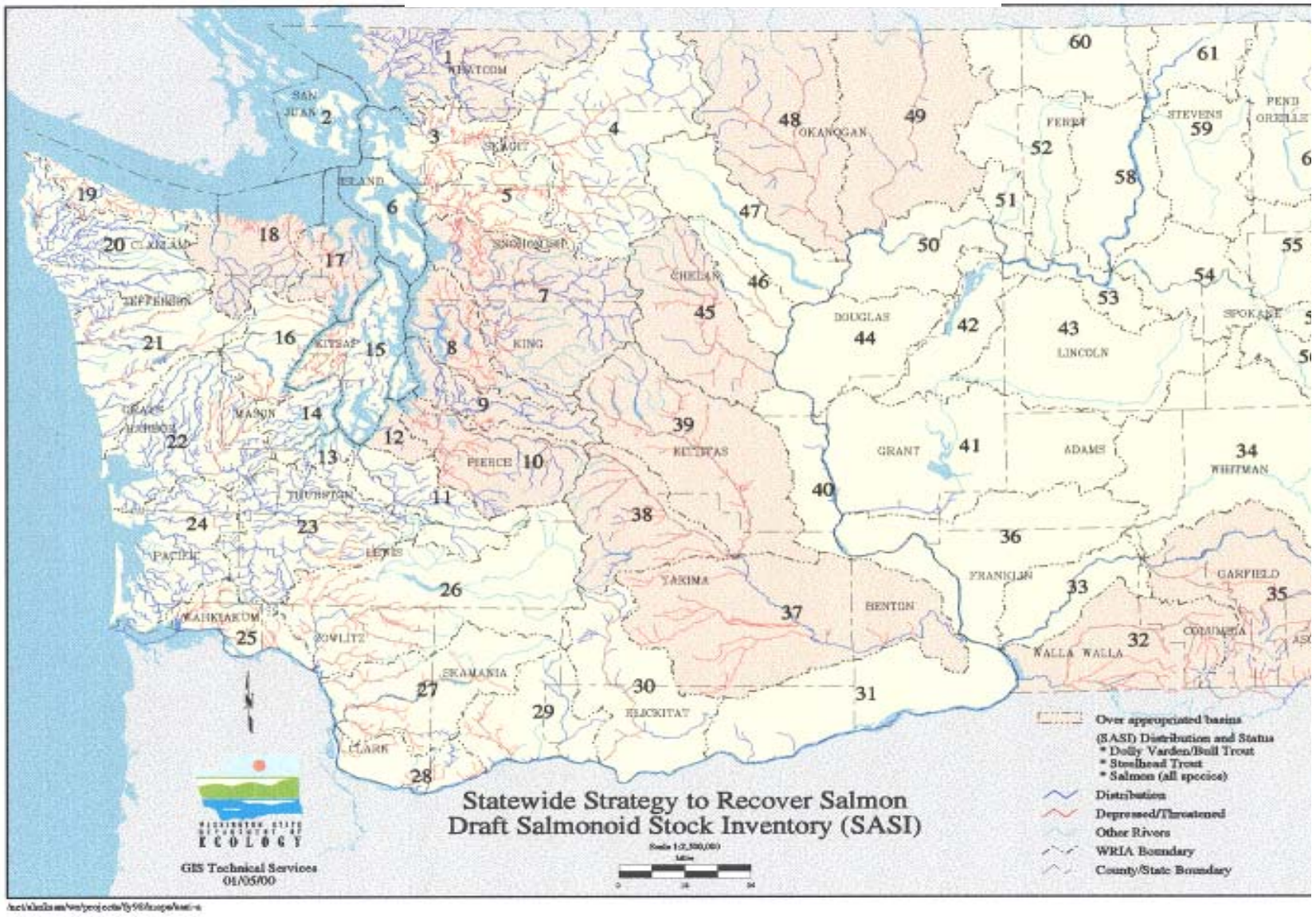
Tennant, Donald Leroy. 1976. Instream Flow Regimens for Fish, Wildlife, Recreation and Related Environmental Resources. *Fisheries* 1(4):6-10; illus.

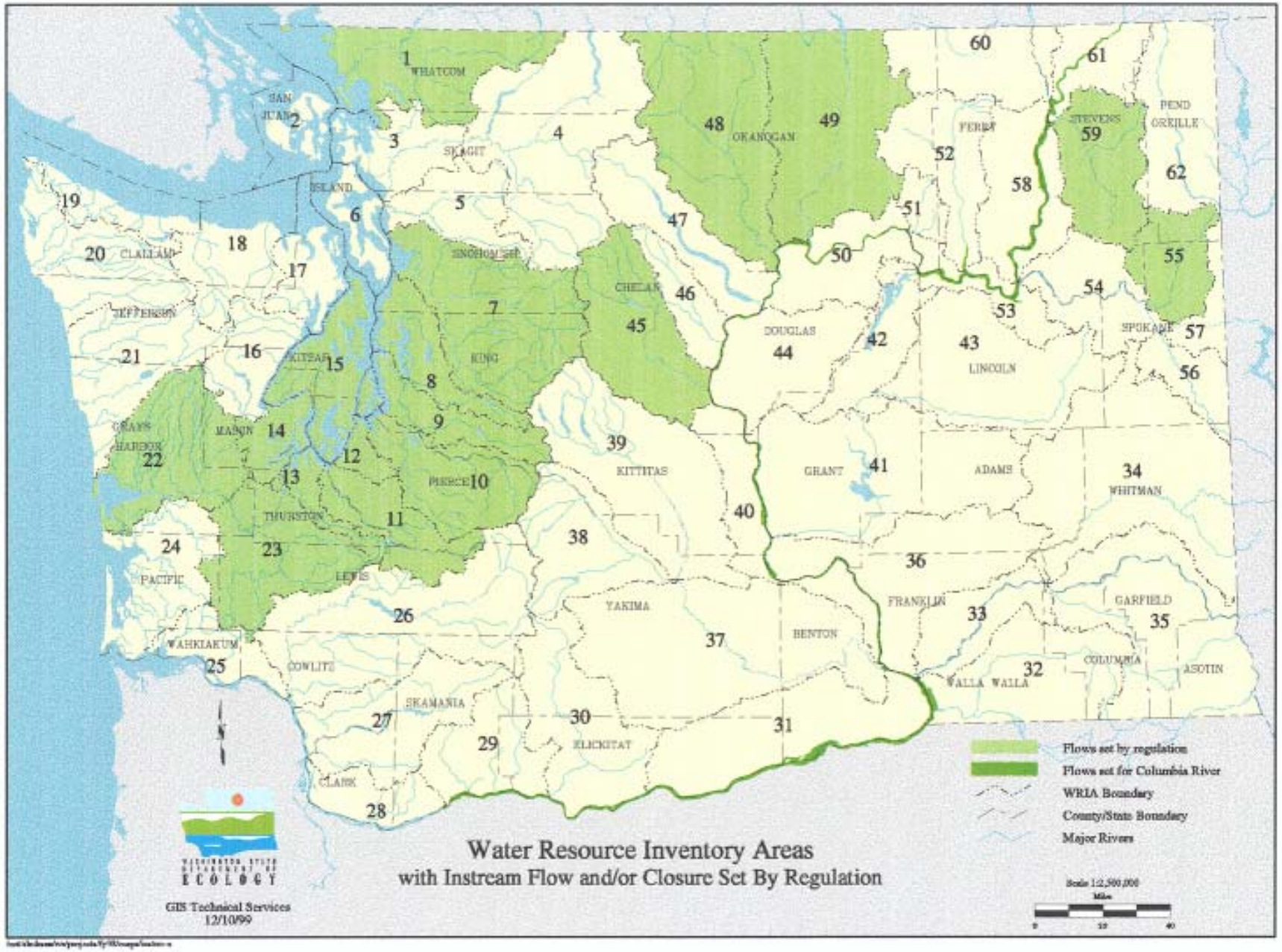
APPENDIX C

Maps

1. Statewide Strategy to Recover Salmon (Shows over-appropriated basins)
2. WRIAs with Instream Flows and/or Closures Set by Regulation
3. Salmon Recovery Regions under the Endangered Species Act
4. Status of Watershed Planning Activities

Over-Appropriated Basins
Statewide Strategy to Recover Salmon




1 WHATCOM
2 SAN JUAN
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7 KING
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10 PIERCE
11 THURSTON
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14 MASON
15 KITSAP
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20 CLALLAM
21 JEFFERSON
22 GRAYS HARBOR
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24 PACIFIC
25 WAHKIAKUM
26 LEWIS
27 COWLITZ
28 CLARK
29 SKAMANIA
30 KLICKITAT
31
32 WALLA WALLA
33 FRANKLIN
34 WHITMAN
35 GARFIELD
36
37 BENTON
38 YAKIMA
39 KITTITAS
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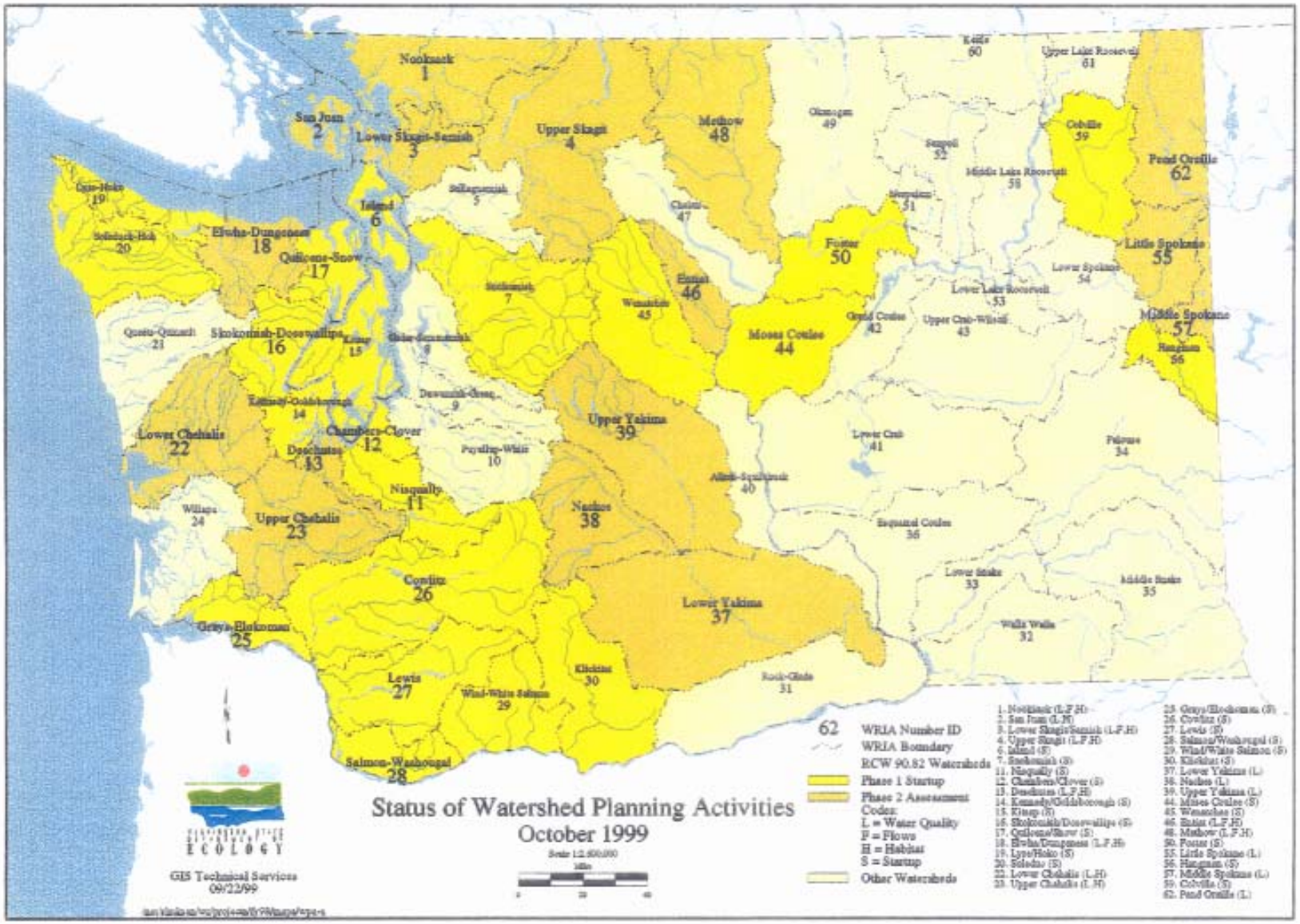
41 GRANT
42
43 LINCOLN
44 DOUGLAS
45
46 CHELAN
47
48 OKANOGAN
49
50
51
52 FERRY
53
54
55
56
57 SPOKANE
58
59 STEVENS
60
61
62 PEND OREILLE
ASOTIN
COLUMBIA
Flows set by regulation
Flows set for Columbia River
WRIA Boundary
County/State Boundary
Major Rivers
Water Resource Inventory Areas
with Instream Flow and/or Closure Set By Regulation
GIS Technical Services
12/10/99

Salmon Recovery Regions

Areas with Salmon, Trout, or Steelhead that are Listed,
Proposed for Listing, or have a High Potential for Future Listing
Under the Endangered Species Act

From: Statewide Strategy to Recover Salmon – *Extinction is Not an Option* (p. III.41)


Nooksack 1
San Juan 2
Lower Skagit-Samish 3
Upper Skagit 4
Island 6
Elwha-Dungeness 18
Quillayute-Snow 17
Hoh-Quillayute 21
Skokomish-Dosewallips 16
Kennedy-Goldsborough 14
Lower Chehalis 22
Deschutes 13
Campbell-Clover 12
Upper Chehalis 23
Willapa 24
Naselle 38
Grays-Elokomin 25
Lewis 27
Salmon-Washougal 28
Wind-White Salmon 29
Klickitat 30
Upper Yakima 39
Lower Yakima 37
Walla Walla 32
Methow 48
Okanogan 49
Foster 50
Entiat 46
Wenatchee 45
Moses Coulee 44
Grand Coulee 42
Upper Crab-Wilson 43
Lower Crab 41
Palouse 34
Alkali-Squilchuck 40
Esquatzel Coulee 36
Lower Snake 33
Middle Snake 35
Colville 59
Pend Oreille 62
Little Spokane 55
Middle Spokane 57
Hangman 56
Lower Lake Roosevelt 53
Upper Lake Roosevelt 61
Middle Lake Roosevelt 58
Status of Watershed Planning Activities
October 1999
ECOLOGY
GIS Technical Services
09/22/99
62 WRIA Number ID
WRIA Boundary
RCW 90.82 Watersheds
Phase 1 Startup
Phase 2 Assessment
Codes:
L = Water Quality
F = Flows
H = Habitat
S = Startup
Other Watersheds